

METHOD FOR PRODUCING A CORROSION-RESISTANT AND OXIDATION-
RESISTANT COATING AND COMPONENT PART HAVING SUCH A COATING

FIELD OF THE INVENTION

The present invention relates to a method for producing a
corrosion-resistant and oxidation-resistant coating.

Furthermore, the present invention relates to a component part
5 having such a coating.

BACKGROUND INFORMATION

When operating component parts, especially components of gas
turbines, at high temperatures, their free surfaces are
10 exposed to strongly corroding and oxidizing conditions. When
used in gas turbines, such components may be made, for
example, of a superalloy based on nickel or cobalt. To
protect them from corrosion, oxidation and even erosion, the
components are furnished with coatings that are produced from
15 metal powders.

A method for producing a corrosion-resistant and oxidation-
resistant slip layer is described in German Published Patent
Application No. 198 07 636. In the method, a slip material is
20 prepared by mixing a binding agent solution with a starting
material containing aluminum or chromium and an additive
powder containing at least one element of aluminum, platinum,
palladium or silicon, the additive powder not including
aluminum in the case of a starting powder that contains
25 exclusively aluminum. According to the method, the slip
material thus prepared is subsequently applied to a component
part and then cured. A heat treatment following the curing is
used to diffuse the slip layer into the component.

30 Accordingly, in the method described in German Published
Patent Application No. 198 07 636, a binding agent, an

additive powder and a starting powder are mixed, and this mixture is applied to the component. In the method, the starting powder is, for instance, pure aluminum, and the additive powder is, for example, pure platinum. When it comes to developing the corrosion-resistant and the oxidation-resistant coating, this is not without problem, since platinum has a tendency to oxidize in response to the heat treatment, and thus to the formation of platinum oxide, which impairs the formation of the coating. The binding agent may also have the effect of forming platinum oxide.

SUMMARY

According to example embodiments of the present invention, a method includes at least the following steps:

- a) making available a component part made of a component part material,
- b) making available a slip material which, besides a binding agent, contains at least one metal powder, the metal powder including at least 25 wt.% of a metal of the platinum group, and
 - b1) is formed of jacketed powder cores, the powder cores being formed from at least one metal of the platinum group; and the jacketing of the powder cores being formed of a material based on the same material as the component part material, or
 - b2) is formed of a metal powder alloy which, besides the at least one metal of the platinum group, includes at least one material based on the same material as the component part material,

c) applying the slip material at least from area to area onto the component part while forming a slip layer,

d) curing and drying the slip layer,

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e) heat treating the component part that is coated with the slip material at least from area to area, in order to diffuse the slip layer into the component part.

10 The powder cores of the metal powder may be formed of platinum and/or palladium, the jacketing of the powder cores being formed of the component part material of the component part that is to be coated. In the case of a turbine blade that is to be coated, which is made of a nickel-based alloy, the
15 powder cores of platinum and/or palladium are jacketed using nickel or a nickel alloy. The jacketing of the metal of the platinum group may suppress the oxide formation of same, and thus may have a positive influence on the formation of the coating.

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The metal powder may be mixed with an aluminum powder and the binding agent to form a Pt-Al slip material, which is processed within the context of the above steps c) through e).

25 Exemplary embodiments of the present invention are explained in more detail below with reference to the appended Figure.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 illustrates a gas turbine blade according to an
30 example embodiment of the present invention having a coating produced according to an example embodiment of the present invention.

DETAILED DESCRIPTION

Example embodiments of the present invention are explained in greater detail below, with reference to Figure 1. Figure 1 illustrates a blade 10 of a gas turbine, which includes a blade 11 as well as a blade root 12. In the illustrated exemplary embodiment, blade 10 is provided all around with a coating 13, the coating 13 being applied onto blade 10. Blade 11 may also be coated from section to section.

Blade 10 as illustrated in Figure 1 may be produced from a nickel-based alloy, and accordingly the nickel-based alloy forms the component part material for the component to be coated, namely for blade 10. It should be understood that the present invention is not limited to the coating of component parts that are produced from a nickel-based alloy. Using example embodiments of the present invention, component parts made of a cobalt-based alloy, an iron alloy or even a titanium alloy may also be coated.

Blade 10 as illustrated in Figure 1 is coated with a so-called slip method. For this, a slip material is made available. The slip material may include a binding agent or a binding agent solution as well as at least one metal powder, the metal powder including up to at least 25 wt.% of at least one metal of the platinum group. It should be understood that the binding agent may be an organic binding agent, and the binding agent solution may be a chromium phosphate solution. However, other binding agents are also able to be used.

Now, it is within the context of a first alternative that a metal powder of jacketed powder cores is formed. The powder cores are formed of at least one metal of the platinum group. The powder cores include either of highly pure platinum, highly pure palladium or of a platinum-palladium mixture, etc. These powder cores are furthermore jacketed. In this context,

the jacketing material corresponds essentially to the component part material of the component part that is to be coated, and in the exemplary embodiment illustrated, it is the component part material of blade 10, that is to be coated. If
5 blade 10, that is to be coated, is produced from a nickel-based alloy, the powder cores of the metal powder are jacketed either by nickel or a nickel alloy. If, on the other hand, a component part is to be coated that is produced from a cobalt-based alloy, the powder cores are jacketed either by cobalt or
10 a cobalt alloy. In the case of a component part that is to be coated and is produced from an iron material, the powder cores of platinum or palladium are jacketed by iron or an iron alloy.

15 Thus, it is within the context of the first alternative to use a metal powder for the slip material whose powder cores are formed of platinum and/or palladium, the powder cores being jacketed using a material whose composition essentially corresponds to the composition of the component part material
20 of the component part that is to be coated.

According to a second alternative, the metal powder is formed from a metal powder alloy which, besides the at least one metal of the platinum group, includes a material based on the
25 same material as that of the component part. A difference from the first alternative is that the jacketed powder cores alloy only upon being heated later, whereas the metal powder alloy is already alloyed.

30 A slip material may be made available which, besides the binding agent, includes aluminum on the one hand, and on the other hand includes the above-described, jacketed powder cores, especially nickel-jacketed platinum cores or a similar metal powder alloy. In this manner, an aluminum-platinum-
35 nickel slip material is made available, which makes possible

an aluminum-platinum coating on the surface of the component part that is to be coated, which in the exemplary embodiment illustrated is blade 10, that is to be coated.

5 For completeness, it should be understood that the slip material, besides the binding agent and the jacketed powder cores or the similar metal powder alloy, is also able to have an MCrAlY metal powder and/or an NiAl metal powder and/or an NiCrAl metal powder, etc. Accordingly, it is possible to make
10 available a slip material which includes at least the binding agent or the binding agent solution, and, in addition, at least the metal powder of the jacketed powder cores or the corresponding metal powder alloy. In addition, aluminum powder or another metal powder may be included in the slip
15 material.

The slip material thus made available may be applied to the component part that is to be coated, in the exemplary embodiment illustrated, that is blade 10. The application is
20 made by brushing on, spraying on, dipping or another suitable method, etc.

After the application of the slip material, while forming a slip layer on the component part, curing and drying of the
25 slip layer takes place. The curing of the slip layer is performed within a temperature range of room temperature up to, e.g., 450°C, e.g., within a temperature range of 350°C to 450°C.

30 After the curing and drying of the slip layer, heat treatment of same takes place for the diffusion of the slip layer into the component part. The heat treatment may take place within a temperature range of, e.g., 750°C to 1250°C, e.g., for approximately two hours. The heat treatment may be carried
35 out under a protective gas atmosphere, for example, in argon.

However, the heat treatment may alternatively take place also in a vacuum or a normal atmosphere.

Because of the use of a jacketed platinum core and/or palladium core as the metal powder, one may avoid that the platinum and/or palladium oxidizes during the heat treatment or caused by the binding agent. Because of this, a clearly better coating of the component part may be implementable.

10 The grain size of the jacketed powder cores or the similar metal powder alloy may be in a range, e.g., between 0.01 μm and 5 μm , e.g., in a range of 0.2 μm to 0.5 μm . The particle shape of the jacketed powder cores may be spherical, in order to ensure a uniform jacketing of same. However, it is also
15 possible to have the particles disk-shaped or plate-shaped.

Moreover, the thickness of the jacketing of the powder cores may be determined such that the percentage proportion of the material of the powder cores lies in a range, e.g., between 25
20 wt.% and 85 wt.%, and accordingly the proportion of the material of the jacketing is between, e.g., 75 wt.% and 15 wt.%. In an exemplary embodiment, in which nickel-jacketed platinum is used as the metal powder, the thickness of the nickel jacketing being selected such that the nickel
25 proportion is between, e.g., 15 and 35 wt.% and the platinum proportion between, e.g., 85 wt.% and 65 wt.%. As was mentioned before, alternatively a metal powder alloy powder having a corresponding composition may be used, that is, having, e.g., 65 wt.% to 85 wt.% platinum and, e.g., 35 wt.%
30 to 15 wt.% of nickel.

Subsequently to the heat treatment of the component part coated with the slip material, for the diffusion of the slip layer into the component part, a separate aluminization of the
35 component part may take place. An aluminum source is made

available for this and aluminum is diffused into the component part that is to be coated.